OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL PHYSICS

(9630)

PAPER 5
Mark scheme

Specimen 2018

V1.1

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Question	Marking guidance	Mark	Comments
01.1	Arrow drawn from **centre** of sphere to **right hand** side of mark ✓	1	
01.2	Time for one oscillation, T = 15.7/10 = 1.57 Time to reach the vertical position = T/4 = 1.57/4 = 0.39 (s) ✓	1	
01.3	Uncertainty in t = ± 0.1 s ✓ % uncertainty in t = 0.1/15.7 × 100% = 0.64(%) 1 or 2 sf only ✓	2	
01.4	Average value of d = 0.750 (m) if all values used ✓ = 0.756 (m) if 0.701 and 0.772 are ignored ✓	2	
01.5	absolute uncertainty in d = $\frac{1}{2}$ × range = $\frac{1}{2}$ × (0.769 – 0.748) = 0.021/2 = 0.011 m ecf from 1.3 ✓	1	
01.6	Use of $d = ut + \frac{1}{2}at^2$ (u = 0) $a = g = 2d/t^2 = 2 \times 0.756/0.39^2 = 9.94\ ms^{-2}$ ✓ %g = %d + %t + %t = (0.011/0.756) × 100 + 0.64 + 0.64 = 1.5 + 0.64 + 0.64 = 2.78% ✓ Absolute uncertainty in g = 9.94 × 0.0278 = ± 0.28 ms^{-2} ✓ 1 or 2 sig figs only	3	

01.7	Increase the length of the pendulum ✓ The period of the pendulum is longer so % uncertainty in t (and g) is smaller ✓ **or** Increase the length of the pendulum ✓ The period of the pendulum is longer so d is larger and % uncertainty in d (and g) is smaller ✓	2	

Question	Marking guidance	Mark	Comments
02.1	No (very little) current flows through the voltmeter✓ (discharge is only through the variable resistor)	1	
02.2	Absolute uncertainty = ± 2.39 × 2/100 = ± 0.05 (V)✓	1	
02.3	[Initial current = V/I = $6/10^{5}$ = 6×10^{-5} = 60μA (which remains constant)] ✓ Charge which flows in 10 s = I × t = 60 × 10 = 600 μC Charge stored by fully charged capacitor = VC = 6× 680 = 4080 μC✓ Number of readings taken = 4080/600 = 6.8 readings (6) ✓	3	
02.4	C = Q/V = Charge flowing/sec/ increase in pd per sec ✓ = 65×10^{-6} / 98×10^{-3} = 663×10^{-6} = 663 (μF) ✓	2	
02.5	Uncertainty in capacitance = ±5% × 680 = ±34 μF ✓ Range of C = 646 to 714 μF so C is within the manufacturers range ✓	2	

02.6	• Circuit with voltmeter in parallel with the capacitor, fixed resistor, cell/power supply, switch/fly lead • 100 k resistor to give time constant of about 50 s • ensure capacitor is discharged, • switch positioned so capacitor is fully charged and measure pd across C • Move switch to discharge C through C and start slop clock at **same time** • Record pd every 10 s until about 3 time constants have elapsed • Plot lnV vs t or plot pd vs t, draw curve and determine time constant Gradient = 1/RC	4 max	Any 4 points

Question	Marking guidance	Mark	Comments
03.1	Check ratios every 50 nm Ratios are not constant so not exponential change (student incorrect) ✓	1	
03.2	Attempt to find D = gradient and tangent drawn at 400 nm and correct readings taken ✓ $(1.6053 – 1.6020)/[(555 – 300) \times 10^{-9}] = 1.29 \times 10^{4}$ (1.19 – 1.36) ✓ m^{-1} ✓	3	
03.3	Values of λ^{-2} shown in table 11.11, 8.16, 6.25, 4.94, 4.00, 3.31, 2.78 ($\times 10^{-6}$) ✓✓ Column heading nm^{-2} or any correct ✓ Minus 1 for each incorrect value To 2 dp	2 1	
03.4	All points plotted correctly to ± 1 mm ✓✓ Minus 1 for each incorrect plot (max –2) Best fit line (can still get this mark if plotting marks lost) ✓	2 1	
03.5	Recognises a = *y*-intecept and = 1.6014 ✓	1	
03.6	a = value of n when $\lambda^{-2} = 0$, ie λ is very large ✓	1	

Question	Marking guidance	Mark	Comments
04.1	Attempt to use volume = mass / density (1.4 / 810 seen) ✓ Condone 0.028 0.00173 (m^3)✓	2	
04.2	Quantity of gas = 1.4 / 0.028 mol or temperature = 298 K used Allow 1.4 / 28 ✓ Use of $pV = nRT$ ✓ Correct answer 1.24 (m^3) ✓	3	
04.3	momentum is conserved ✓ gas ejected (backwards) so its momentum changes / it is given momentum (*ejected gas has momentum OWTTE)* or force needed to produce change in momentum ✓ equal and opposite change in momentum of the astronaut equal and opposite force on the astronaut ✓ *NB not momentum of astronaut = momentum of gas*	3	
04.4	Use of $F = ma$ 3.56 / 151 seen ✓ 0.024 ($m\ s^{-2}$) ✓	2	

04.5	Attempt to apply conservation of momentum ✓ (151 × 3.05) / 1.4 ✓ 329 (330) ($m\ s^{-1}$)✓	3	
04.6	Time for which rocket accelerates given by final $v = at$ *(t = 3.05 / 0.024)* ecf from 4.4 ✓ *or ma = 3.56 = (dm / dt) v* t = 127 − 129 s ecf ✓ *or 151 × (i) = (dm / dt) × (ii)(ecf)* ✓ 1.4 / their time 0.011 (kg) *0.011 (kg) ecf*✓	3	
04.7	gas does work as it expands / *W* is negative ✓ *ΔU* is negative (allow temperature of gas falls) ✓ Q = 0 / No thermal energy input or output ✓	3	
04.8	kg m s^{-2} ✓	1	

Question	Marking guidance	Mark	Comments
05.1	$C = \varepsilon_o \varepsilon_r A/d$ ✓ 15.6 (nF) or 16 (nF) ✓	2	
05.2	2.4×10^9 (V) ✓	1	
05.3	$\frac{1}{2} CV^2$ (or $\frac{1}{2}QV$ if attempt to calculate Q made) ✓ $4.3–5.0 \times 10^{10}$ (J)✓	2	
05.4	36–40 (C) ✓	1	
05.5	recognition that 1% of charge or voltage remains ✓ any appropriate form of decay equation (either exponential or logarithmic) ✓ 3.48×10^6 **(**Ω) cao (but do not allow if physics error) ✓	3	

Question	Marking guidance	Mark	Comments
06.1	insert control rods (further) into the nuclear core / reactor ✓ which will absorb (more) neutrons (reducing further fission reactions) ✓	2	a change must be implied for 2 mark marks by use of (further) or (more) allow answers that discuss shut down as well as power reduction If a statement is made that is wrong but not asked for limit the score to 1 mark (eg wrong reference to moderator)
06.2	fission fragments / daughter products or spent / used fuel / uranium rods (allow) plutonium (produced from U-238) ✓ *not uranium on its own*	1	
06.3	γ (electromagnetic radiation is emitted) ✓ as the energy gaps are large (in a nucleus) as the nucleus de-excites down discrete energy levels to allow the nucleus to get to the ground level / state ✓ mark for reason	2	A reference to α or β loses this first mark 2nd mark must imply energy levels or states
06.4	momentum / kinetic energy is transferred (to the moderator atoms) or a neutron slows down / loses kinetic energy (with each collision) ✓ (eventually) reaching speeds associated with thermal random motion or reaches speeds which can cause fission (owtte) ✓	2	

Question	Marking guidance	Mark	Comments
07.1	Use of $\boldsymbol{T = 2\pi\sqrt{\frac{l}{g}}}$ 48.7 (49) (m)✓	1	
07.2	v = 120 000 / 3600 = 33(.3) m s^{-1} ✓ Total tension = 6337 + (280 × 9.81) = 9.083 × 10^3 N Allow their central force ✓ Divide by 4 2.27 × 10^3 (N) Allow their central force ✓	3	
07.3	$mgh = \frac{1}{2} mv^2$ *Condone: Use of $v = 2\pi fA$ (max 2)* 9.8 × 44 = 0.5 v^2 Allow 45 in substitution ✓ *Condone 22 m s^{-1}* 29.4 m s^{-1} (Use of 45 gives 29.7) ✓ 106 km h^{-1} (their m s^{-1} correctly converted) Or compares with 33 m s^{-1} ✓	3	